CLAIMS: I claim:

1. A method for heating a medium, said medium comprising hydrocarbonaceous material, comprising:
   (a) subjecting said medium to an alternating current electrical field generated by a radio frequency waveform applied at a predetermined frequency range that heats said medium;
   (b) measuring an effective load impedance initially dependent upon the impedance of said medium;
   (c) comparing said effective load impedance with an output impedance of a signal generating unit that generates said radio frequency waveform; and
   (d) automatically adjusting said effective load impedance to match an output impedance of said signal generating unit.

2. The method of claim 1 wherein said output impedance of said signal generating unit is a predetermined constant.

3. The method of claim 2 wherein said output impedance of said signal generating unit is about 50 ohms.

4. The method of claim 1 wherein measuring said effective load impedance includes measuring a voltage across said medium and measuring a resulting electric field developed in said medium.

5. The method of claim 1 wherein measuring said effective load impedance includes measuring a current of said radio frequency waveform applied to the medium.

6. The method of claim 1 wherein measuring said effective load impedance includes measuring a voltage and a current of said radio frequency waveform applied to said medium, and determining a phase angle based on the measured voltage and

measured current.

7. The method of claim 1 wherein measuring said effective load impedance includes measuring a forward power level of said radio frequency waveform applied to generate a voltage across and current through said medium and a reverse power level of said radio frequency waveform reflected from an effective load.

8. The method of claim 7, further comprising calculating a voltage standing wave ratio from said forward power level and said reverse power level.

9. The method of claim 8, further comprising repeating the act of automatically adjusting said effective load impedance until said voltage standing wave ratio is about 2:1 or less.

10. The method of claim 8, further comprising repeating the act of automatically adjusting said effective load impedance until said voltage standing wave ratio is about 1:1.

11. The method of claim 1 wherein automatically adjusting said load impedance to said output impedance of said signal generating unit includes adjusting said selected frequency of said applied radio frequency waveform.

12. The method of claim 1 wherein automatically adjusting said effective load impedance to match said output impedance of said signal generating unit includes tuning a tunable impedance matching network connected to an effective load.

13. The method of claim 1, further comprising periodically measuring at least one temperature of said medium during heating, and using said measured temperature

in automatically adjusting said effective load impedance to match said output impedance of said signal generating unit.

14. The method of claim 1 wherein of said radio frequency waveform allows for a wavelength to be at least ten times greater than a longest geometrical dimension of the medium under test.

15. The method of claim 1 wherein said selected frequency of said radio frequency waveform is in a range of 1 mhz to 300 mhz.

16. The method of claim 1 wherein said hydrocarbonaceous matter in said medium is contained in a subterranean environment.

17. The method of claim 1 wherein said medium is of hydrocarbonaceous matter, and of said radio frequency waveform is greater than about 30 mhz.

18. The method of claim 1, further comprising exposing said medium to a subterranean reservoir of a carrier medium, said carrier medium being a fluid which allows radio frequency waves to travel to said medium.

19. The method of claim 18 wherein said medium is heated while exposed to said reservoir of said carrier medium.

20. The method of claim 18 wherein said medium that is generally adjacent to said reservoir is heated, said carrier medium in said reservoir being maintained at a temperature range below boiling point of said carrier medium.

21. The method of claim 1 wherein a desired compound within said medium forms a recoverable layer within said reservoir, and said recoverable layer can be extracted from said reservoir.

22. A method for heating a hydrocarbon-bearing formation, comprising:

(a) subjecting said hydrocarbon-bearing formation to an alternating current field produced by applying a radio frequency waveform at a predetermined variable frequency with a signal generating unit, said signal generating unit having a generally constant output impedance;

(b) measuring an actual impedance of said hydrocarbon-bearing formation;

(c) determining an effective load impedance, said effective load impedance initially dependent upon said actual impedance of said hydrocarbon-bearing formation, said effective load impedance being determined by at least one of measuring a voltage and current of an applied radio frequency waveform and computing a phase angle difference, and measuring a forward power level of said radio frequency waveform applied to said hydrocarbonaceous matter and a reverse power level of said radio frequency waveform reflected from said hydrocarbon-bearing formation with circuitry of said signal generating unit;

(d) comparing said effective load impedance with said output impedance of said signal generating unit; and

(e) automatically matching said effective load impedance to said output impedance of said signal generating unit by at least one of adjusting the frequency at which said radio frequency waveform is applied and tuning a tunable impedance matching network such that said effective adjusted load impedance is approximately equal to said output impedance of signal generating unit.

23. A method for heating a hydrocarbon-bearing formation, comprising:

maintaining a hydrocarbonaceous matter in an alternating current electrical field generated by a radio frequency waveform at a frequency not greater than 300 mhz

provided by a signal generating circuitry, said hydrocarbonaceous matter originating from said hydrocarbon-bearing formation and being contained in a subterranean reservoir; and

controllably heating said hydrocarbonaceous matter by automatically maintaining an impedance match between said hydrocarbonaceous matter and a signal generating circuitry, said signal generating circuitry providing said radio frequency waveform.

24. A method for heating a hydrocarbon-bearing formation, comprising:

maintaining at least one hydrocarbonaceous compound within a subterranean environment in an alternating current electrical field, said electrical field provided by a radio frequency waveform, said hydrocarbonaceous compound originating from said hydrocarbon-bearing formation;

periodically sensing an impedance of said hydrocarbonaceous compound and undesired organic and inorganic compositions to produce a sensor output signal;

determining impedance mismatch based on a difference between a most recently sensed impedance and a known impedance, and generating a corresponding control signal output that corresponds to said difference with a computer; and

as said hydrocarbonaceous compound and undesired organic and inorganic compositions increase in temperature, adjusting said frequency of said radio frequency waveform by said control signal output of said computer such that said impedance matches said most recently sensed impedance.

25. A method of separating a hydrocarbonaceous matter from undesired matter commonly associated with a hydrocarbonaceous formation, comprising:

maintaining hydrocarbonaceous matter and undesired matter in an alternating current electrical field provided by a radio frequency waveform, said hydrocarbonaceous formation being exposed to a subterranean reservoir, said reservoir comprising a fluid carrier medium, said fluid carrier medium allowing passage of said radio frequency waveforms to penetrate and heat said hydrocarbonaceous formation;

periodically sensing an impedance of said hydrocarbonaceous matter and said fluid carrier medium to produce a sensor output signal;

determining an impedance mismatch based on a difference between a most recently sensed impedance and a known impedance, and generating a corresponding control signal output that corresponds to said difference with a computer; and,

as said hydrocarbonaceous matter and said fluid carrier medium increase in temperature, adjusting said frequency of said radio frequency waveform by said control signal output of said computer such that said sensed impedance matches said most recently sensed impedance, such that said hydrocarbonaceous matter will rise in temperature and decrease in viscosity, and thus rise to the surface of said reservoir and dropping out said undesired matter to settle as sediment in said reservoir.

26. A method for heating a hydrocarbon-bearing formation, comprising:

testing a first sample of a hydrocarbonaceous material to determine a first impedance of at least one targeted chemical composition at several different temperatures;

storing a resulting impedance vs. temperature information for said targeted chemical composition in a memory of a computer;

flowing a signal through a second sample of said hydrocarbonaceous material, said signal being at a radio frequency not greater than 300 mhz for said targeted chemical compositions;

sensing a second impedance of at least one portion of a second sample;

determining, by operation of said computer, a relationship between a most recently sensed impedance of said hydrocarbonaceous material and a heating rate of said targeted chemical compositions; and

adjusting a heating rate of said targeted chemical composition based on said relationship.

27. A method for heating specific chemical compositions that reside in hydrocarbonaceous material, comprising:

maintaining hydrocarbonaceous material in an alternating current electrical field provided by a radio frequency signal at a frequency not greater than 300 mhz; and

controllably heating said hydrocarbonaceous material by automatically maintaining an impedance match between an impedance of said hydrocarbonaceous material and a predetermined constant, said predetermined constant comprising an optional fluid carrier medium (for example, water, a saline solution, carbon dioxide), which can be unaffected, when desired, by the frequencies being presented to the target elements within the formation

28. A capacitive radio frequency dielectric heating apparatus for hydrocarbonaceous matter, the apparatus comprising:

maintaining a source of an alternating current radio frequency signal at an radio frequency not greater than 300 MHz, the source being connected to a pair of electrodes on opposite sides of a product treatment zone to cause an radio frequency signal to generate an alternating current electric field in the product treatment zone;

a frequency controller to adjust the frequency of the radio frequency signal between different radio frequencies;

a mathematical model that predicts impedance of the specific chemical compositions within the hydrocarbonaceous matter as a function of temperature;

an impedance sensor to sense an impedance of the specific chemical compositions within the hydrocarbonaceous matter; and

a computer programmed to receive impedance data from the impedance sensor, to process the impedance data using the model for the product, and to apply a control signal to the frequency controller to adjust the frequency of the radio frequency signal to match the sensed impedance to a predetermined impedance.

29. The apparatus of claim 28 wherein the source of the alternating current signal

includes a frequency generator connected to a power amplifier.

30. The apparatus of claim 28 further comprising an impedance matching network tunable to match the output impedance of the power amplifier to the impedance of a load comprising the pair of electrodes and any product in the product treatment zone between the two electrodes.

31. The apparatus of claim 28 further comprising a directional coupler coupled to a transmission line leading from the power amplifier to receive signals proportional to levels of power supplied from the amplifier.

32. The apparatus of claim 28 wherein the directional coupler includes a forward power portion that receives signals proportional to the power supplied by the amplifier and a reverse power portion that receives signals proportional to power reflected back to the amplifier.

33. The apparatus of claim 28 comprising a measurement instrument connected to receive the respective signals from the forward and reverse power portions.

34. The apparatus of claim 28 wherein the measurement instrument computes a voltage standing wave ratio.

35. The apparatus of claim 28 wherein the measurement device computes a load reflection coefficient.

36. The apparatus of claim 28, wherein the computer is connected to and receives input signals from the measurement instrument, and the received signals are processed with the temperature data in generating the control signals.

37. A capacitive radio frequency dielectric heating apparatus for heating specific chemical compositions within the hydrocarbonaceous matter, the apparatus

comprising:

a source of an alternating current radio frequency signal at a frequency not greater than 300 MHz;

a first electrode that is connected to the source; a second electrode that is connected to the source and that is spaced from the first electrode so that a product treatment zone is defined between the electrodes and an radio frequency signal flows through the product treatment zone; and

impedance matching means for matching an impedance of the heated specific chemical compositions within the hydrocarbonaceous matter to a predetermined constant by adjusting the frequency of the radio frequency signal.

38. The apparatus of claim 37 wherein each of the first and second electrodes have multiple electrode elements which are electrically isolated from one another, individual elements of the first electrode being located opposite corresponding individual elements of the second electrode to provide multiple pairs of opposed electrode elements.

39. The apparatus of claim 37 wherein a computer-controlled switch is connected in the radio frequency signal supply circuit for each pair of electrodes so that individual electrode pairs can be turned off and on by the computer.

40. The apparatus of claim 37 further comprising temperature sensors, and wherein at least some of the temperature sensors are supported on the first electrode.

41. A capacitive dielectric radio frequency heating apparatus for heating specific chemical compositions within hydrocarbonaceous matter, the apparatus comprising:

at least one pair of spaced-apart electrodes defining a treatment zone that can accommodate specific chemical compositions within the hydrocarbonaceous matter to be heated;

signal generating circuitry connected to the electrodes, the signal generating circuitry being capable of providing an alternating current radio frequency signal to charge the electrodes and generate an alternating current electric field in the heat treatment zone;

impedance measuring circuitry connected to the electrodes and to the signal generating circuitry, the impedance measuring circuitry measuring an impedance of the electrodes and the specific chemical compositions within the hydrocarbonaceous matter within the treatment zone; and

a controller linked to the impedance measuring circuitry and the signal generating circuitry, the controller controlling the signal generating circuitry and the alternating current electric field generated thereby based on the impedance measured by the impedance measuring circuitry.

42. The apparatus claim 41, wherein the signal generating circuitry includes a variable frequency radio frequency signal generator.

43. The apparatus of claim 41, wherein the signal generating circuitry includes an amplifier connected to the variable frequency radio frequency signal generator.

44. A capacitive radio frequency dielectric heating apparatus for heating specific chemical compositions within hydrocarbonaceous matter, the apparatus comprising:

a source of an alternating current radio frequency signal at a radio frequency not greater than 300 MHz, the source being connected to a pair of electrodes on opposite sides of a product treatment zone to cause an radio frequency signal to flow through the product treatment zone;

a frequency controller to adjust the frequency of the radio frequency signal between different radio frequency frequencies;

a mathematical model that predicts Debye resonance frequency as a function of

temperature for a specific chemical composition to be heated by the apparatus;

a temperature sensor to measure the temperature of a specific chemical composition located in the zone; and

a computer programmed to receive temperature data from the temperature sensor, to process the temperature data using the model for the product, and to apply a control signal to the frequency controller to adjust the frequency of the radio frequency signal to a Debye resonance frequency of the product at the sensed temperature in the zone.

45. The apparatus of claim 44 wherein: the model provides Debye resonance frequency information for multiple chemical compositions that reside in hydrocarbonaceous matter; and the apparatus further comprises an input device to tell the computer what type of product is located in the zone.

46. The apparatus of claim 44 wherein the input device input device also tells the computer what type of chemical composition is located in the zone.

47. The apparatus of claim 44 wherein:

the model is a data table that contains Debye resonance frequencies for at least one chemical composition at various temperatures.

48. The apparatus of claim 44 wherein the model is a mathematical model that predicts the Debye resonance frequencies for various chemical compositions based on the dielectric properties of the chemical compositions.

49. The apparatus of claim 44 further comprising a field strength controller that responds to signals from the computer to adjust the power level of the radio frequency signal in the zone.

50. A capacitive radio frequency dielectric heating apparatus for heating chemical compositions that reside in hydrocarbonaceous matter, the apparatus comprising:

a source of an alternating current radio frequency signal at a frequency not greater than 300 MHz;

a first electrode that is connected to the source; a second electrode that is connected to the source and is spaced from the first electrode so that a treatment zone is defined between the electrodes and a radio frequency signal flows through the treatment zone;

multiple temperature sensors positioned to measure the temperature at multiple regions of the hydrocarbonaceous matter located in the zone; and

a computer which receives temperature data from the temperature sensors, processes the temperature data using a model for the chemical compositions, and adjusts at least one characteristic of the radio frequency signal in response to changes in the sensed temperatures in the zone.

51. The apparatus of claim 50 wherein each of the first and second electrodes have multiple electrode elements which are electrically isolated from one another, individual elements of the first electrode being located opposite corresponding individual elements of the second electrode to provide multiple pairs of opposed electrode elements.

52. The apparatus of claim 50 wherein a computer-controlled switch is connected in the radio frequency signal supply circuit for each pair of electrodes so that individual electrode pairs can be turned off and on by the computer.

53. The apparatus of claim 50 wherein at least some of the temperature sensors are supported on the first electrode.

54. The apparatus of claim 50 wherein the said treatment zone is within a pipe.

55. The treatment zone of claim 54 wherein the hydrocarbonaceous material is a slurry that is heated and released under hydrostatic pressure.